Air & Space

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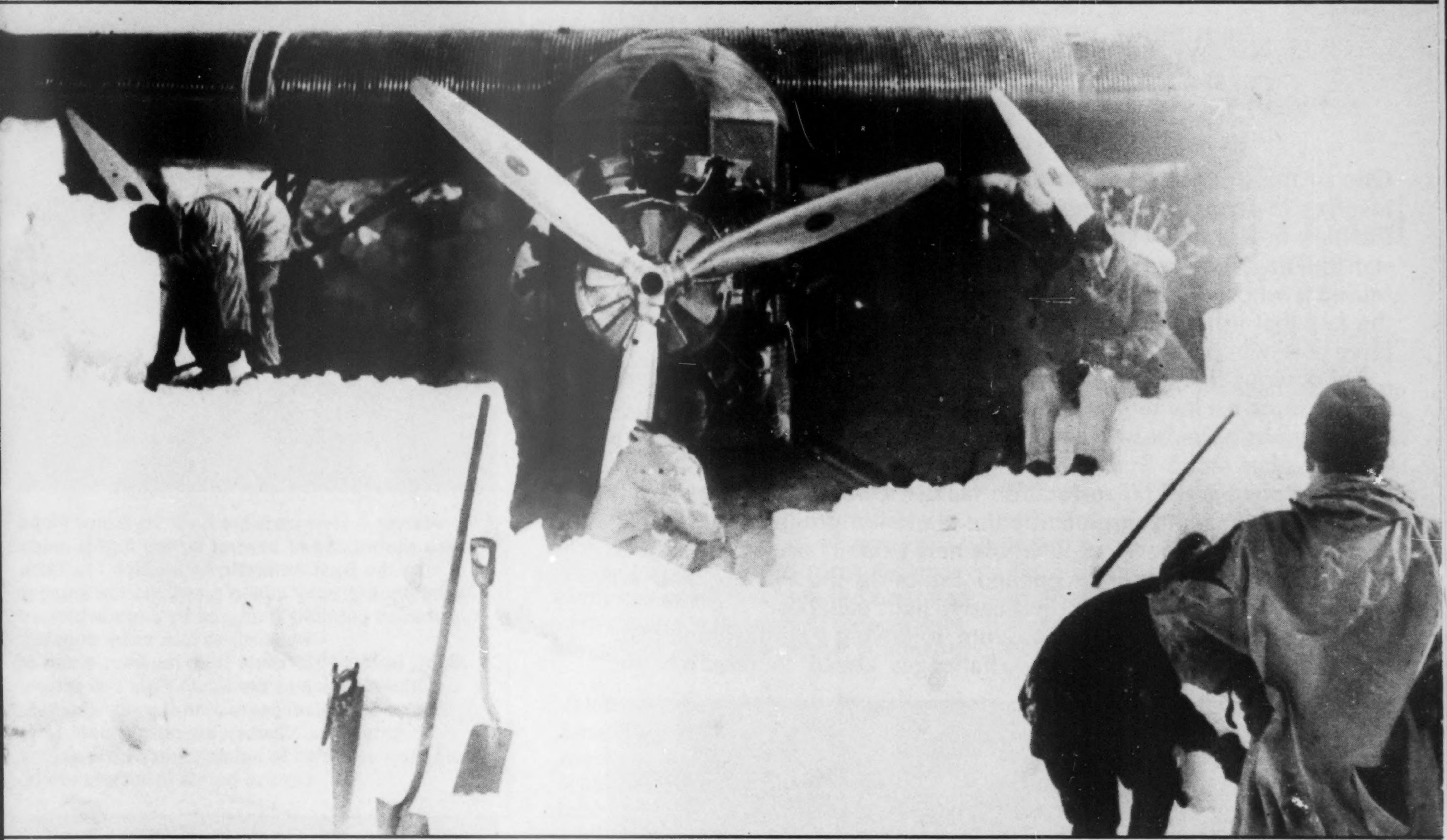


Unlocking Antarctica's Secrets from Above

Just 50 years ago next month, Commander Richard E. Byrd (right) and a crew of three stared down at the bleak, windswept Antarctic plain 600 meters (2,000 feet) below their Ford Tri-motor airplane. Somewhere on that vast, featureless expanse of white lay the geographic South Pole. They were the first men ever to gaze from the air upon that spot which, as Byrd wrote later in Little America, **was ". . . only a white desolation and solitude disturbed by the sound of our engines. . . . One gets there, and that is about all there is for the telling. It is the effort to get there that counts." In masterful understatement Byrd thus summarized the crowning achievement of a carefully planned and executed expedition whose goals also included extensive aerial surveying of the frozen continent. Byrd Antarctic Expedition I spent more than a year in Antarctica, much of the time huddled in the base camp at Little America, enduring temperatures as low as −57° C (−79° F) and gale winds over 120 kilometers/hour (75 miles/hour). Flying during the brief Antarctic summer, Byrd and his crew made several far-reaching flights, mapping and photographing hundreds of square miles of previously uncharted territory. Today, aircraft and remote-sensing and navigational satellites are building rapidly upon the pioneering work that Commander Byrd and other early Antarctic aviators began a half century ago.** (More, pages 2-4)

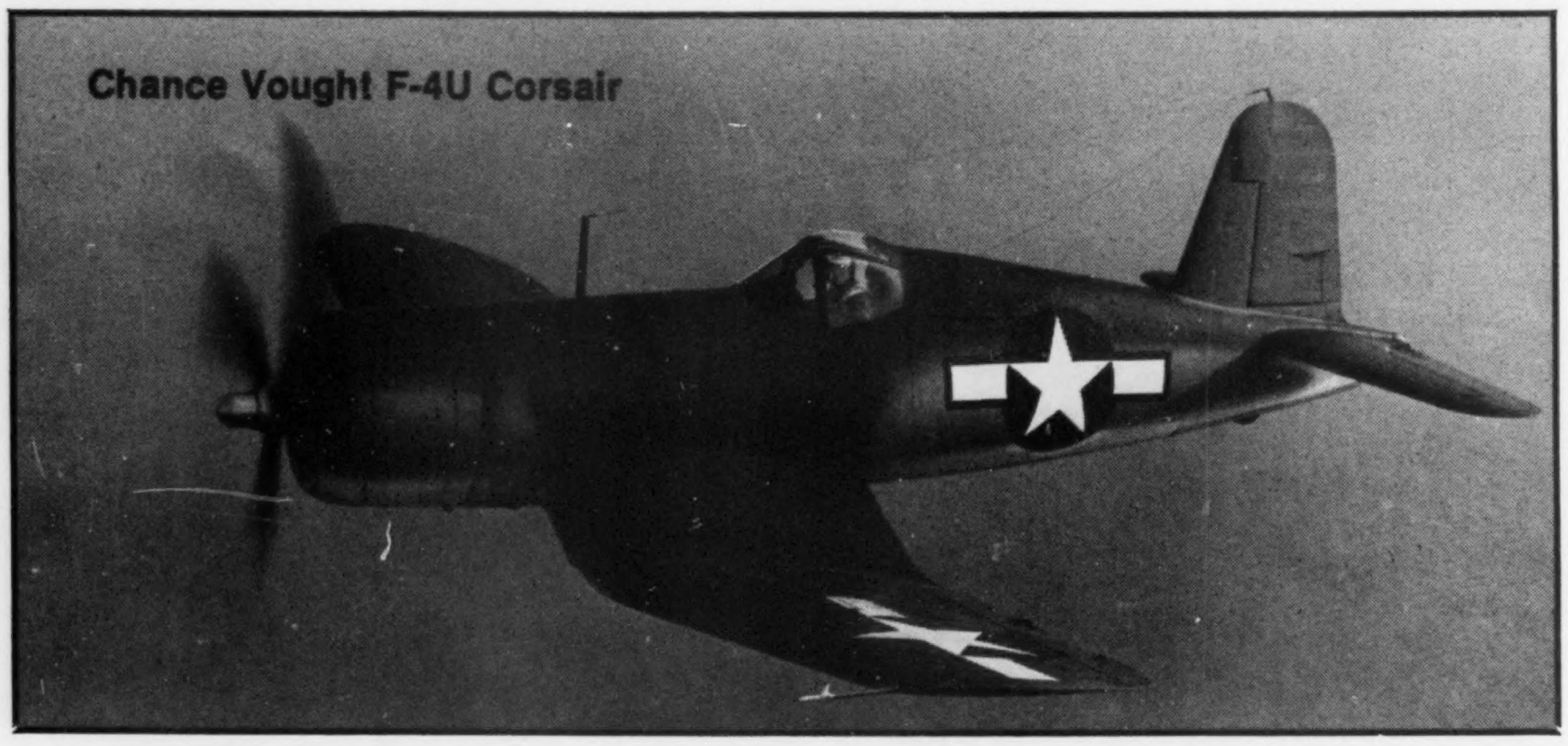
Briefing

Noel W. Hinners
Director, NASM

One of the first things anyone new to a job does is to see what it involves in terms of people, money, facilities, and projects, and to examine how those relate to goals. Clearly, my predecessors and the staff did an exemplary job in building and equipping an outstanding Museum whose acceptance by the public is amply demonstrated by the fact that it has welcomed more than 31 million visitors in its first three years of operation.

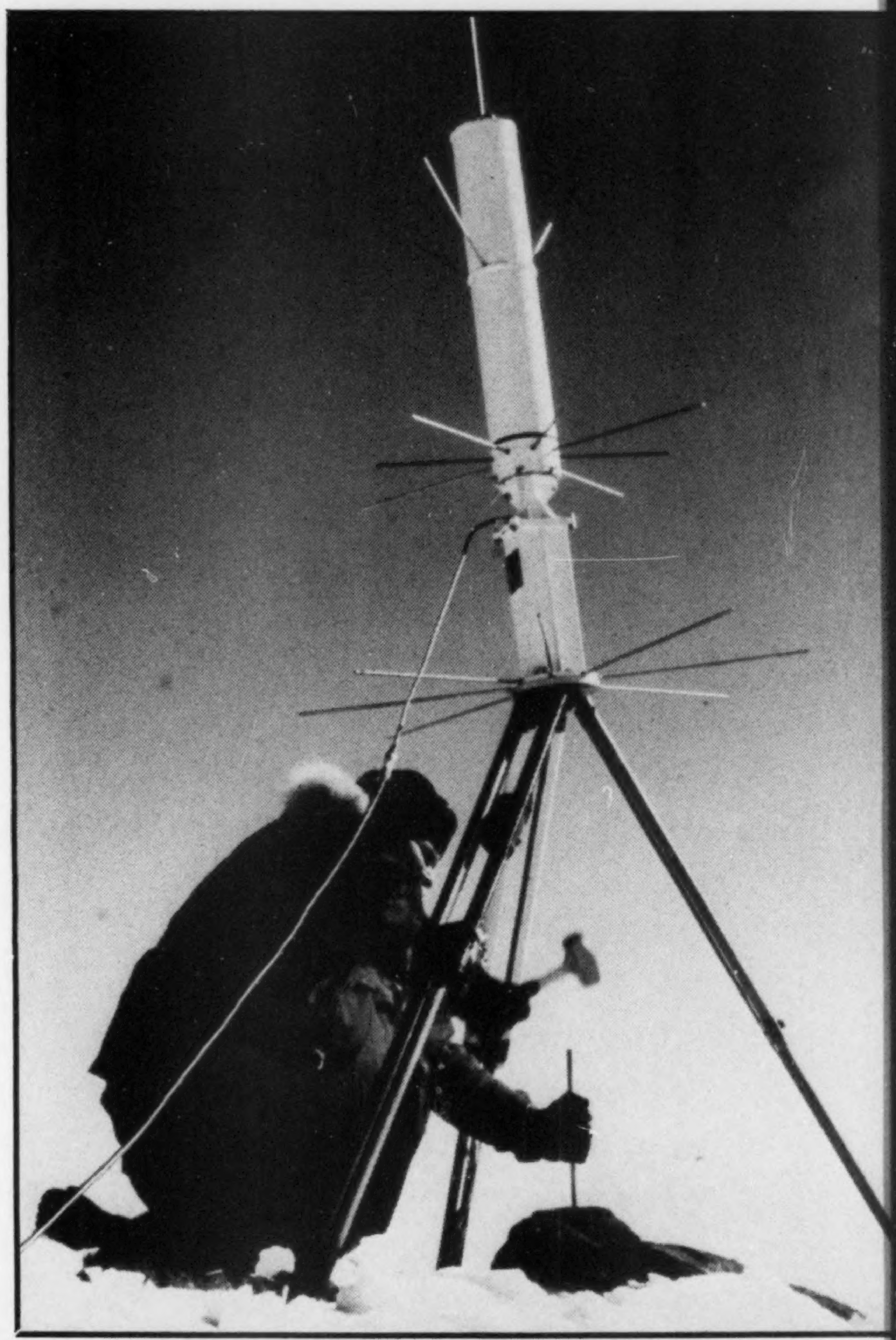
My obvious first challenge is to assure that the Museum maintains the sense of excitement and inspiration that attracts the public. As NASM grows older, it is essential we keep our exhibits dynamic. One way we plan to do that is by using many of the artifacts that are stored at our Silver Hill restoration facility. (We'll soon bring in the F-4U Corsair, made so popular by the television program *Ba Ba Black Sheep*.) We're also developing whole new exhibits on timely subjects —for example, we recently opened Exploring the Planets, and are now working on Jet Aviation and Early Flight galleries.

The National Air and Space Museum, following a Smithsonian Institution tradition, has some new challenges ahead in research and education. We recognize that we have the world's best collection of air and space artifacts, the largest museum public audience, and a skilled staff, and that aeronautics and astronautics are essential parts of the U.S. economy and our day-to-day lives. Research, using chiefly artifacts and library resources, is essential to telling the story of our artifacts, to examining and telling the history of where we have been and how we got where we are, and to seeing where we might be headed.



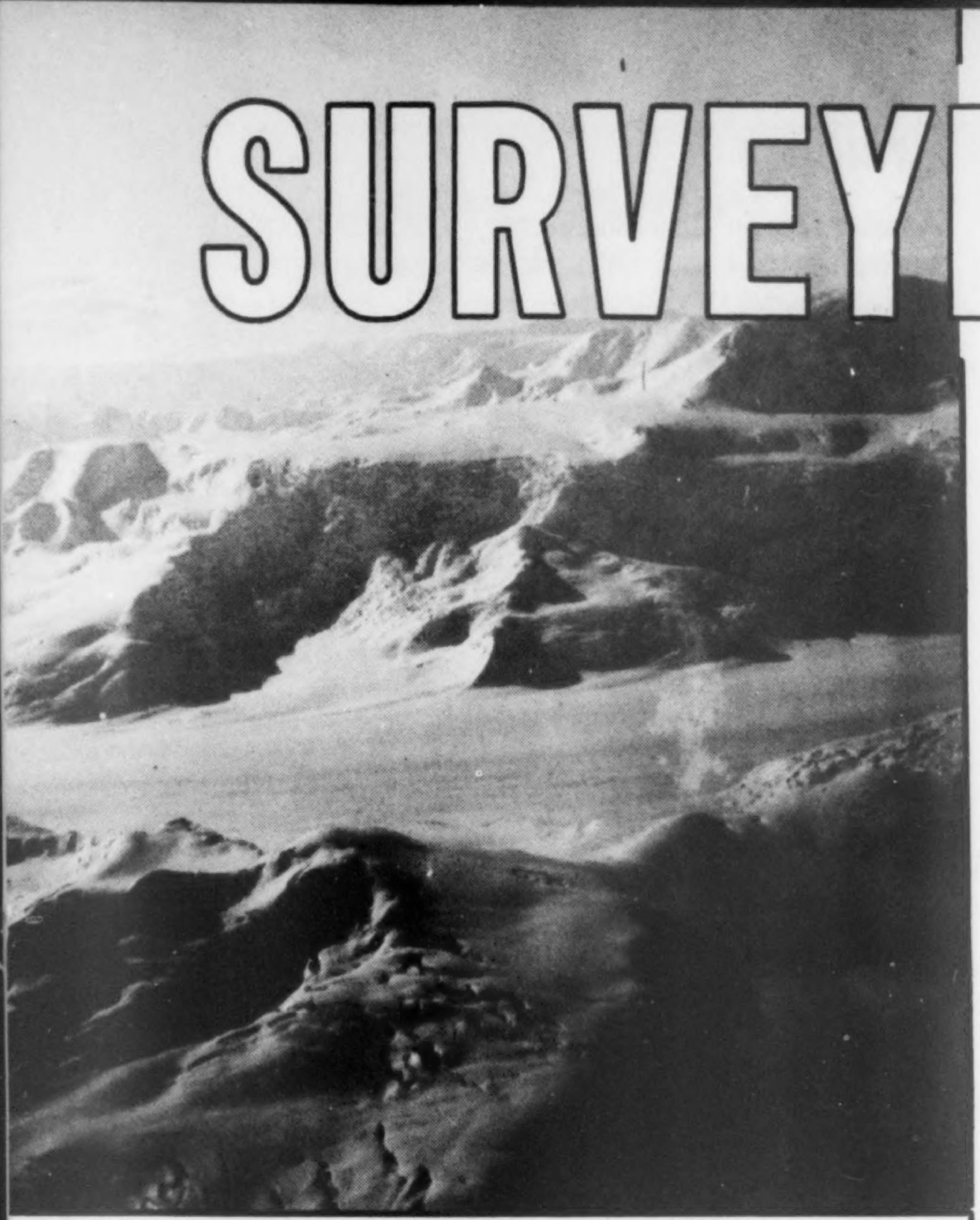
A broad-based education program is somewhat new to many museums but, in my view, is entirely consistent with our prime job as curator and chronicler of air and space artifacts and history. The education programs that we are building constitute one way of capitalizing upon the resources of the National Air and Space Museum, making them available to the public (including those who can't get to Washington), and telling the exciting story of the past and future of air and space. That over 30,000 of you requested and use *Air & Space* tells me that we're on the right wavelength.

Above: A view from the Ford Tri-motor *Floyd Bennett* during one of several survey flights made by the Byrd Antarctic Expedition I in 1929. Aerial photography added greatly to the meager information painfully gathered by early explorers traveling on foot or by dogsled. Right: Byrd's 1929 route from his base camp at Little America to the South Pole and return. Below: Geoceiver station on Gomez Nunatak, Antarctica. Geoceivers collect data from navigation satellites to establish accurate survey control points in remote areas.



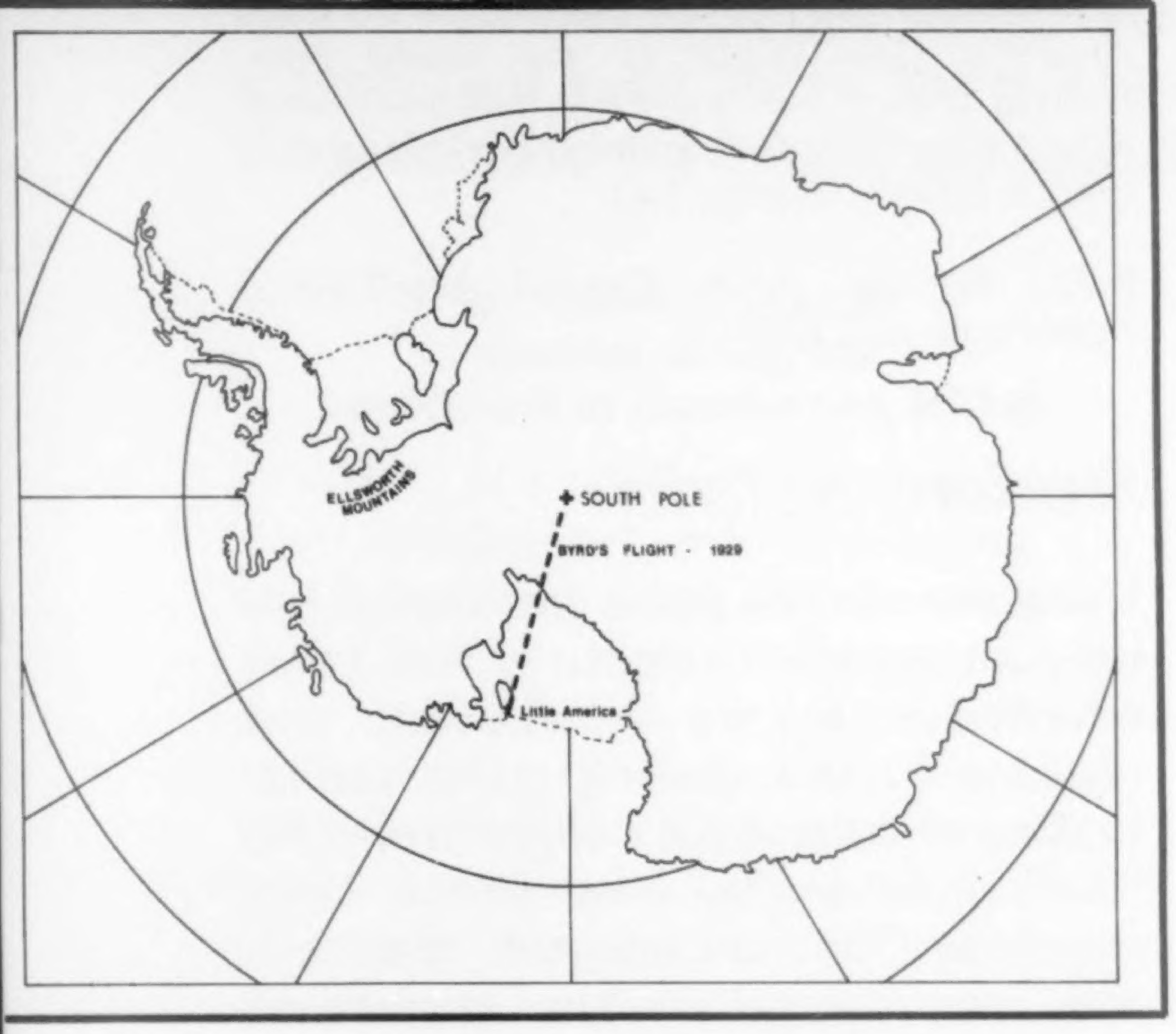
SURVEYING ANTARCTICA

from dogsled to satellite



"Of all the flights I have ever made, none was so full of excitement and profit as this one. An air of impending drama foreshadowed every mile of progress. North, east, south, and west—everything that was there was unseen and untrodden and unknown."

Cmdr. Richard E. Byrd
December 5, 1929



by Richard S. Williams, Jr.
and James W. Schoonmaker, Jr.
U.S. Geological Survey

Just 50 years ago, on Nov. 29, 1929, USN Cmdr. Richard E. Byrd sent an historic radio message from his Ford Tri-motor *Floyd Bennett* to his colleagues huddled in their snowswept base camp at Little America on Antarctica's Ross Ice Shelf: "My calculations indicate that we have reached the vicinity of the South Pole. Flying high for a survey. Byrd."

Byrd and his crew—Chief Pilot Bernt Balchen, Copilot/Radioman Harold June, and Aerial Surveyor/Photographer Ashley McKinley—were the first men to view the South Pole from above the surface of the Earth.

On July 22, 1972, the first Landsat satellite (formerly called ERTS-1) was successfully launched into a circular, near-polar orbit. Traveling around the Earth every 103 minutes at an altitude of about 915 kilometers (570 miles), Landsat can acquire a new image of a part of the Earth every 25 seconds. The path of Landsat ranges between latitudes 81° north and south and passes within about 885 kilometers (550 miles) of the geographic North and South Poles.

Tremendous progress has been made in the last 50 years in our ability to observe the vast regions of Antarctica. As swift as this technological development has been, it is only the most recent chapter in the story of the scientific surveys of this little-known continent.

Although the early exploration of Antarctica occurred mainly in the surrounding seas during the hunting of seals and whales, it was not until the latter part of the 19th century that the Antarctic continent was believed to be sufficiently important to warrant a scientific survey.

Several major expeditions were then launched over the next several decades to acquire geographic, meteorological, geological, and biological information. The most famous of these was led by the Norwegian explorer, Roald Amundsen, whose party reached the geographic South Pole on Dec. 14, 1911, returning to their coastal base on Jan. 12, 1912. Amundsen and his party had traveled 3,000 kilometers (1,860 miles) in 99 days, using skis and dog teams. They averaged about 1.3 kilometers/hour (0.8 miles/hour), including stops for rest and bad weather.

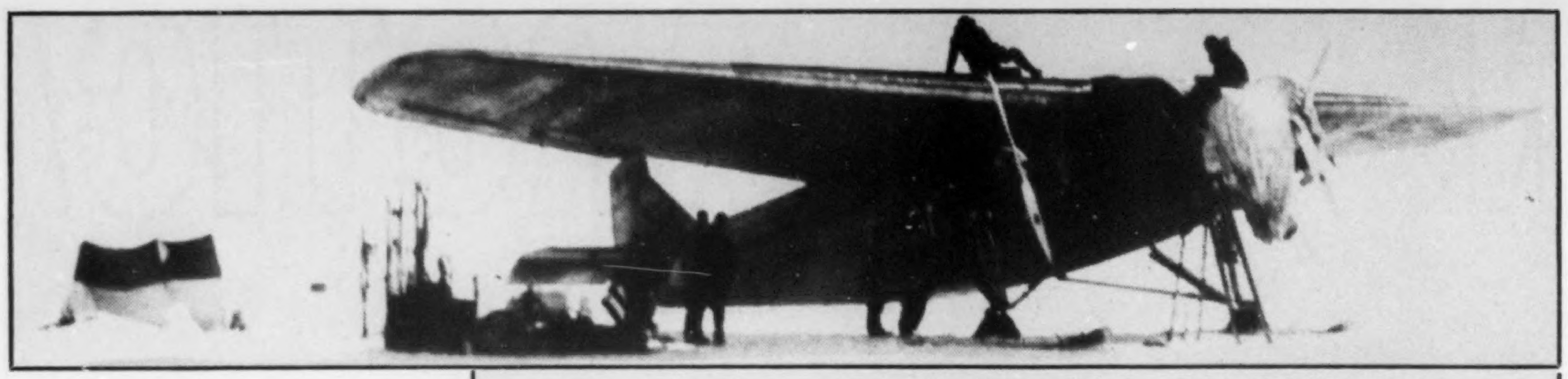
Progressing more slowly than Amundsen, Robert Falcon Scott and his party of fellow Britons reached the South Pole on Jan. 18, 1912. Scott had attempted to use Siberian ponies to reach the polar plateau via the heavily crevassed, 160-kilometer (100-mile) Beardmore Glacier, but the ponies were not suited for travel on ice and eventually died. Consequently, the polar party had to traverse much of the distance by man-hauling their sledges. Exhausted by the ordeal, Scott and his four companions perished on the return trip.

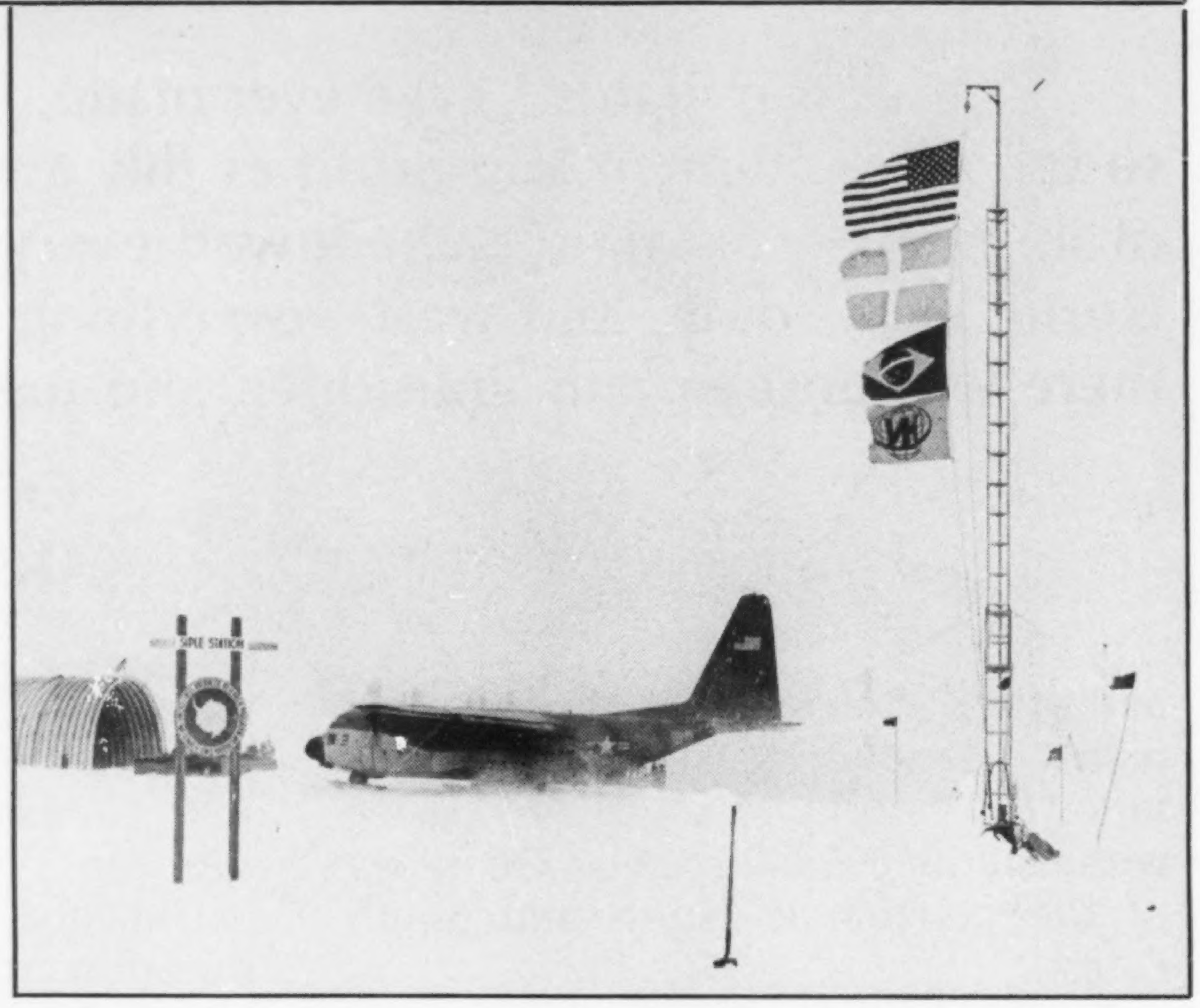
Until the motorized transport introduced by the British explorer Ernest Shackleton in 1907 became reliable, skis and sledges were the normal means of surface transport for scientific surveys. Tracked vehicles allowed increased mobility, normally traveling about 3-10 kilometers/hour (2-6 miles/hour), depending on snow surface conditions, crevasse danger, and load.

The first Byrd Antarctic Expedition (BAE I) was not the first scientific expedition to use an airplane in Antarctica. The Wilkins-Hearst Expedition preceded BAE I by about 11 months. The Wilkins-Hearst surveys, however, were limited mainly to the coastal areas of the continent.

The introduction of the airplane into Antarctic exploration by the Wilkins-Hearst Expedition and its extensive deployment by Byrd heralded a new era. Transportation of equipment, supplies, and people—including emergency rescue — could be accomplished with more speed and safety than previously possible. New methods, which included aerial photography for terrain mapping and geology, radio echosounding for glaciology, and airborne magnetometry for geomagnetics, greatly accelerated scientific data collection.

During the Wilkins-Hearst Expedition, a substantial number of aerial photographs were acquired. Later, William R. MacDonald, a U.S. Geological Survey cartographer supported by the U.S. Navy, planned the acquisition of aerial photographs over more than 2.6 million square kilometers (1 million square miles) of the continent. He also pioneered the use of Landsat images in mapping Antarctica.

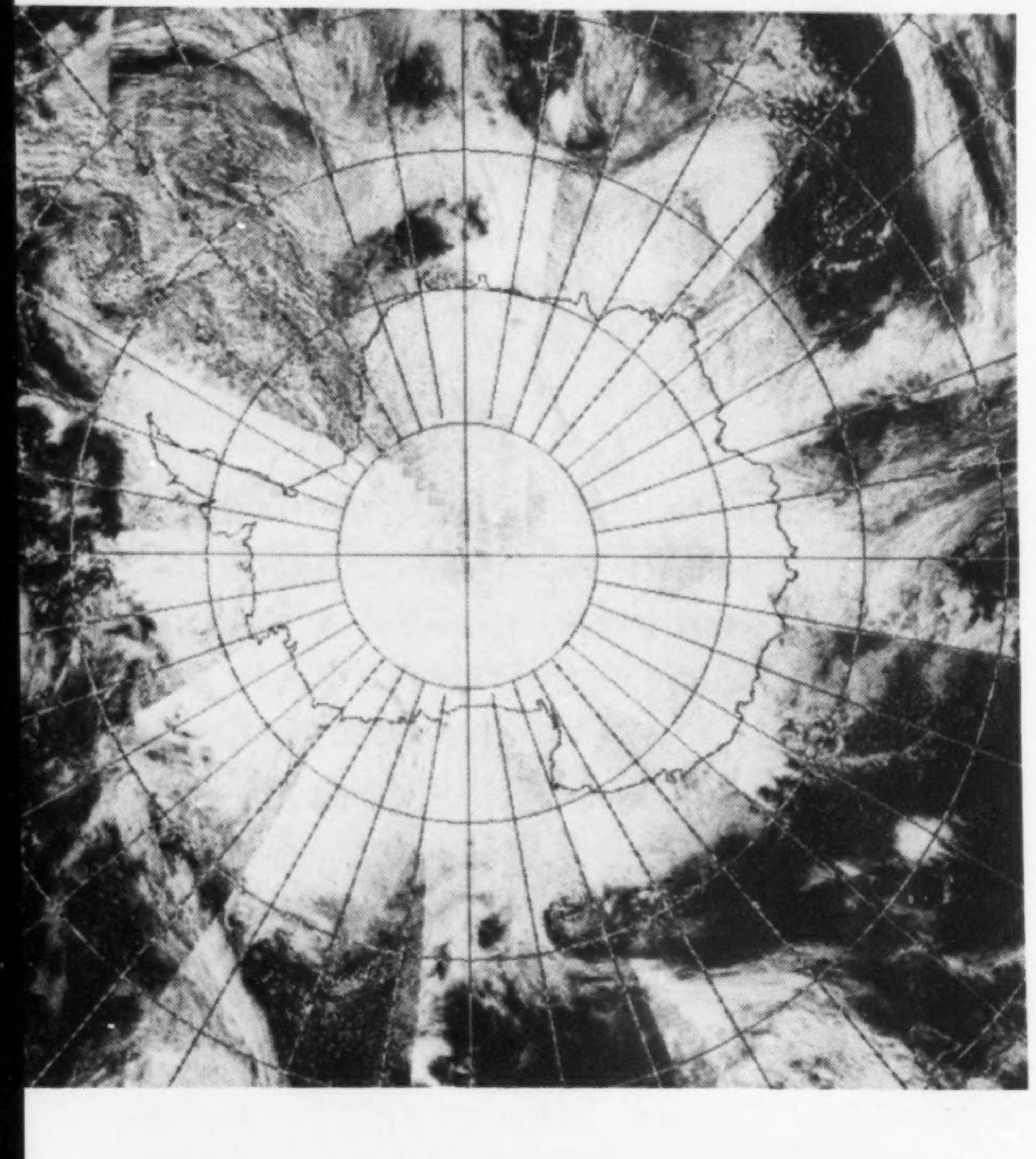




Above: Byrd's crew took a month's emergency rations on the first south polar flight—and had to jettison them to clear mountains in their path. Right: The Lockheed C-130 Hercules four-engine turboprop, outfitted with skis and wheels, is the current workhorse of the Antarctic skies, shuttling scientists and equipment to and from permanent research stations on the white continent.

In the past, surface traverses were needed to tie the elevations and locations of interior geographic features into those of coastal features by costly and time-consuming conventional geodetic surveys. These surveys were needed to position the numerous aerial photographs necessary to make a map.

By the late 1960's, however, satellite technology began to be applied to Antarctica, a process that is still continuing. Navigation satellites permit very accurate independent surveys to be established. These surveys provide control for conventional maps, whereas Landsat provides imagery that is inexpensive, timely, easy to acquire, and extremely suitable for image maps. Landsat images of Antarctica further speed up scientific research in Antarctica by permitting vast areas to be mapped, either from individual images, or from mosaics of images. The U.S. Geological Survey's satellite image map of McMurdo Sound, Antarctica, was made from a single Landsat image and portrays an area that is 185 kilometers (115 miles) on a side and encompasses 34,255 square kilometers (13,225 square miles).



Photomosaic of Antarctica as seen by NOAA-2 during a 25-hour, 13-orbit survey, Oct. 4-5, 1974.

Base maps of Antarctica are needed at scales of 1:250,000 to plot scientific data, yet after 20 years of a major mapping effort, only about 20 percent of the continent has been accurately mapped using aerial photographs and ground surveys. Encompassing nearly 14.3 million square kilometers (5.5 million square miles), Antarctica still presents a formidable mapping task.

Except for the area around the geographic South Pole, Landsat could, in just a few years, provide the images to planimetrically map Antarctica at such scales as 1:250,000. Just 11 Landsat images would encompass the same area mapped to date at a 1:250,000 scale. Navigation satellite data from ground stations can provide the necessary horizontal and vertical ground control in many areas. Other polar orbiting satellites could be used to establish elevation profiles of the ice surfaces on Antarctica. If this presently available space technology is fully utilized, the scientific exploration of the huge Antarctic continent will be greatly accelerated, fulfilling one of the goals Commander Byrd began to work toward 50 years ago.

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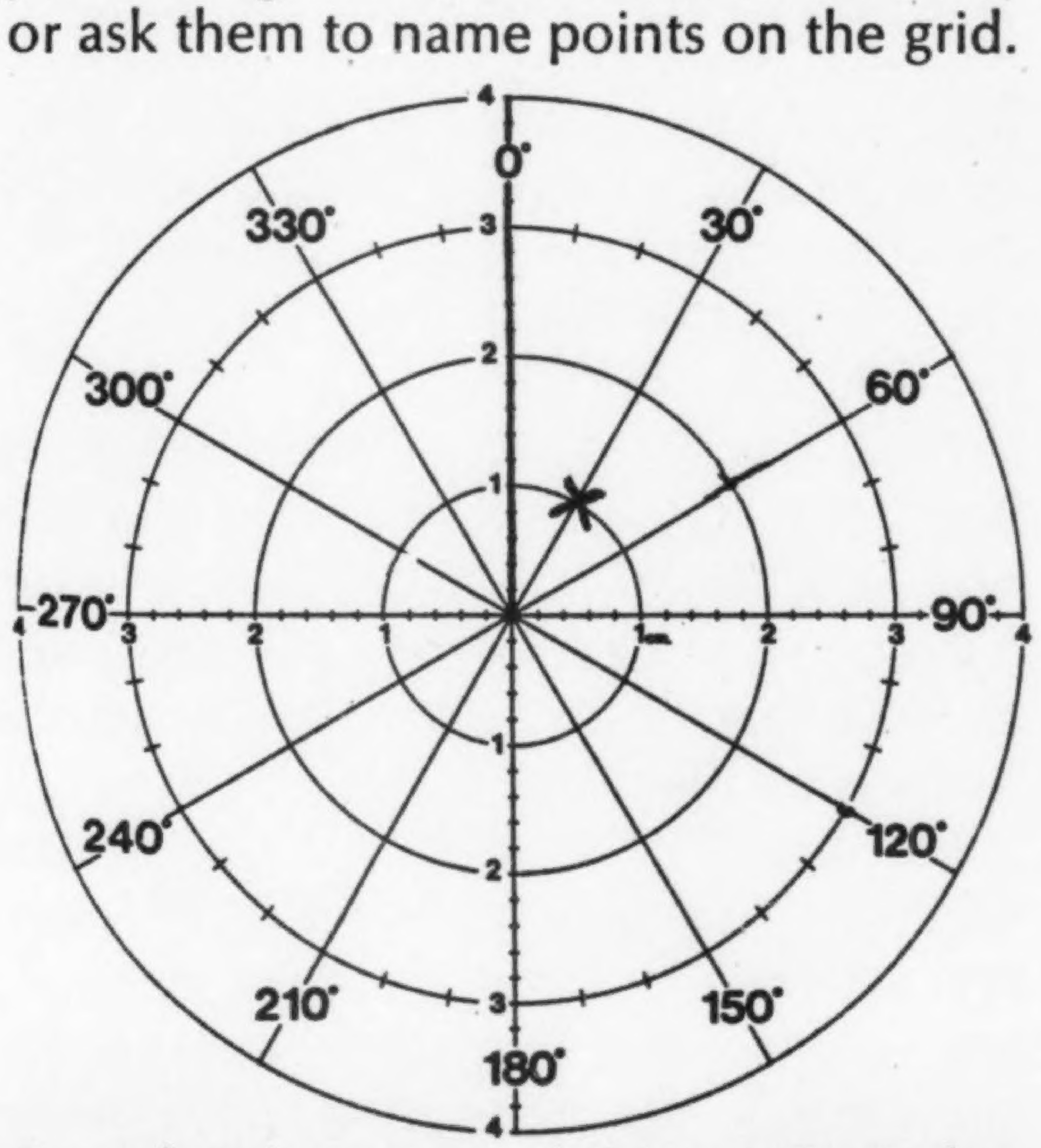
Student Activity

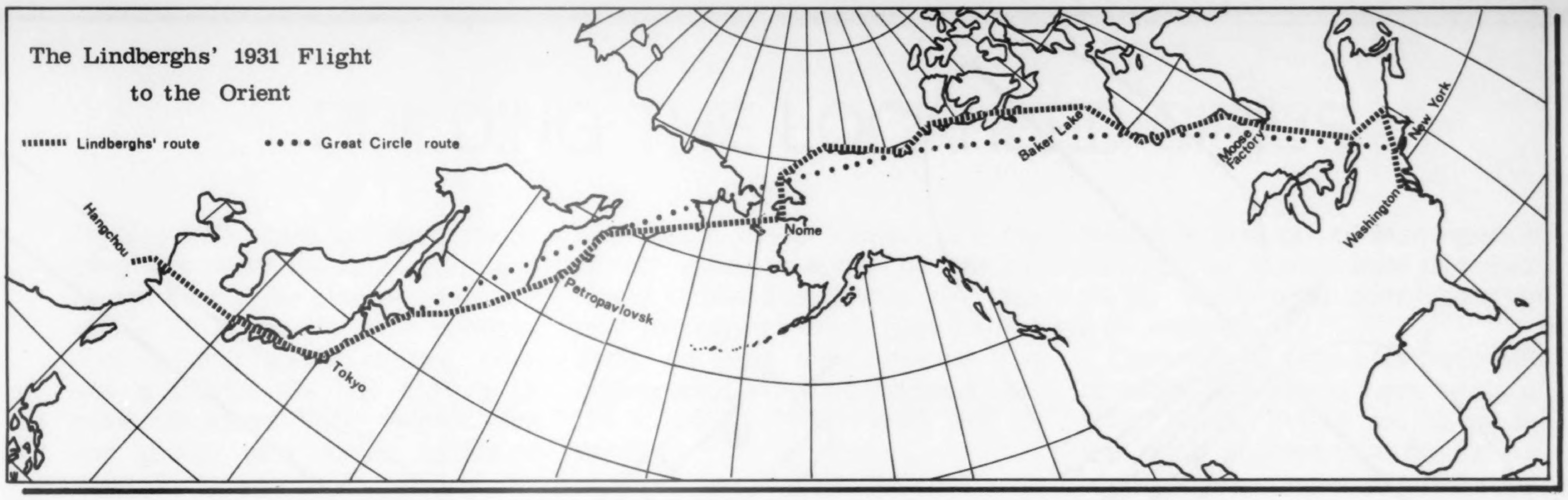
Using the sample polar grid shown below, encourage students to use polar coordinates to specify direction and distance from a starting point, similar to Commander Byrd's flight from the South Pole to his base camp, Little America. The zero-degree direction may be oriented in any convenient way, e.g., at geographical north, or along the route an airplane is headed.

Polar coordinates are expressed in parentheses—first the direction, in degrees, then the distance from the center of the coordinate system. For example, (30°, 1 cm) is marked by the X in the sample grid.

Give students polar coordinates to plot on a grid similar to the one shown, or ask them to name points on the grid.



Reproduced courtesy of Science Curriculum Development Study, Lawrence Hall of Science, University of California, Berkeley.



"A Flying Vacation"

was what the Lindberghs called their 1931 flight from New York to China in their Lockheed Sirius. The trip also pioneered the polar great circle route to the Orient, and speeded public acceptance of air travel.

by Robert C. Mikesh
Curator of Aircraft
Department of Aeronautics, NASM

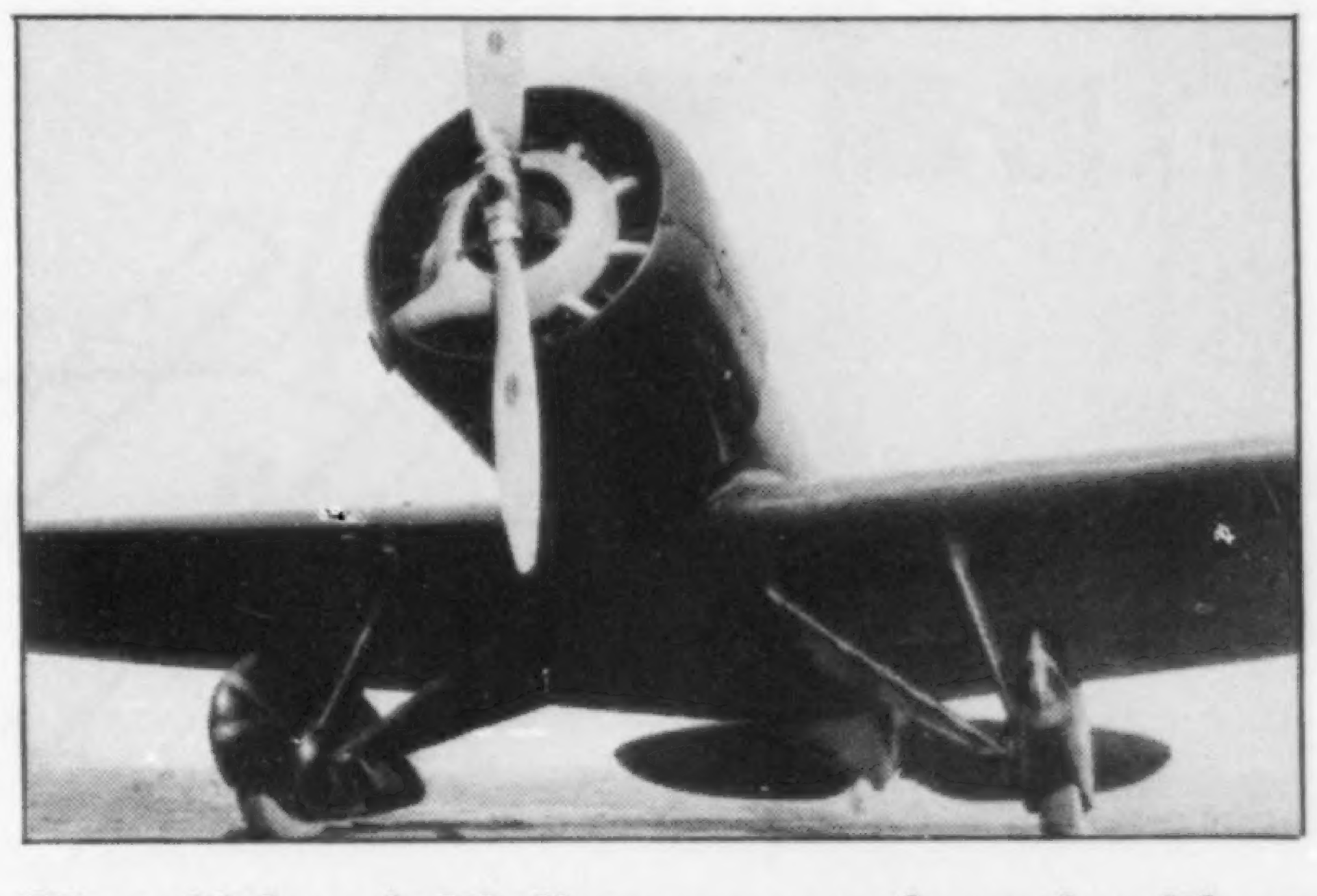
It was with a spirit of fostering public air-mindedness and developing dependable, long-range air transportation that Col. Charles A. Lindbergh and his wife Anne were busily preparing to fly to the Far East in July, 1931. The Lindberghs called this flight a "flying vacation," but they had a greater purpose in mind. No air routes had been charted yet for the shorter Great Circle route to the Orient, and the Lindberghs planned to survey and plot such a route.

The Lockheed Aircraft Company had developed a new airplane, the Sirius, especially for the Lindberghs. The Sirius used the basic components of the Lockheed Vega, a versatile monoplane proven by such air pioneers as Wiley Post with his *Winnie Mae*. But unlike the standard high-wing Vega, the Sirius had a low wing. Lindbergh felt the low-wing configuration would facilitate safer forced landings, faster rough-field takeoffs (due to increased ground effect), and a better field of view in airport traffic.

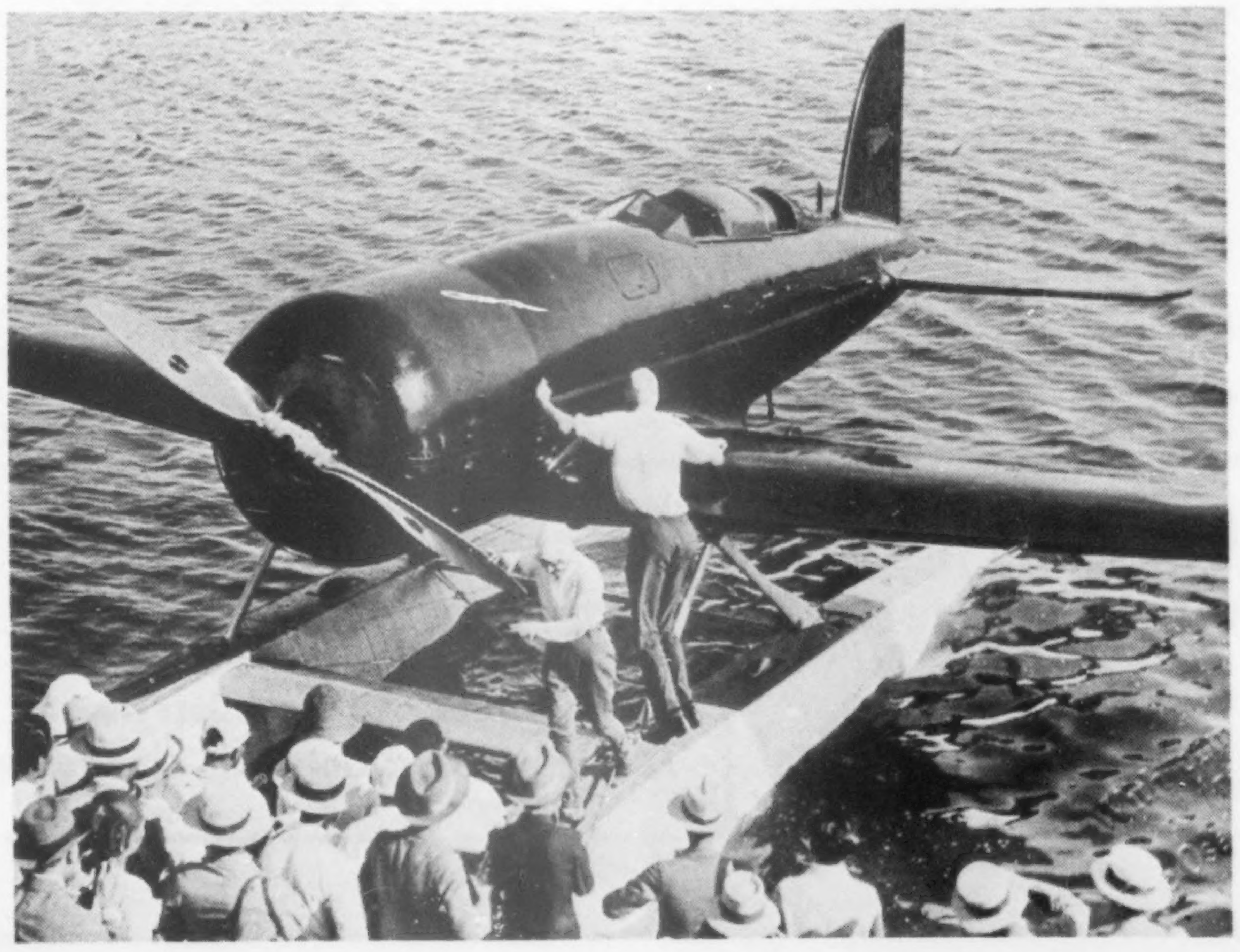
The Lindberghs flew their new plane, initially equipped with wheels, from Los Angeles to New York on April 20, 1930, setting a new transcontinental record of 14 hours, 4 minutes.

On July 27, 1931, they took off from New York on the first leg of their long flight to the far side of the world. They flew their Sirius—now equipped with Edo floats—across Canada and Alaska, along Siberia, and down the Kurile Islands to Japan.

After being welcomed in Tokyo as heroes, the Lindberghs flew on to China, where they learned of the ravages of the flooding Yangtze River and offered medicine and supplies.



The Sirius initially was equipped with a wide landing gear providing better ground handling than the narrow gear of the high-wing Vega from which it was derived.



The Lindberghs received a warm welcome when they arrived in Tokyo in 1931. Their Lockheed Sirius, fitted with floats for their largely overwater flight, carried them safely over trackless tundra and stormy seas, only to be damaged in China by a groundhandling mishap. The Lindberghs later used the repaired craft to pioneer air routes across the Atlantic.

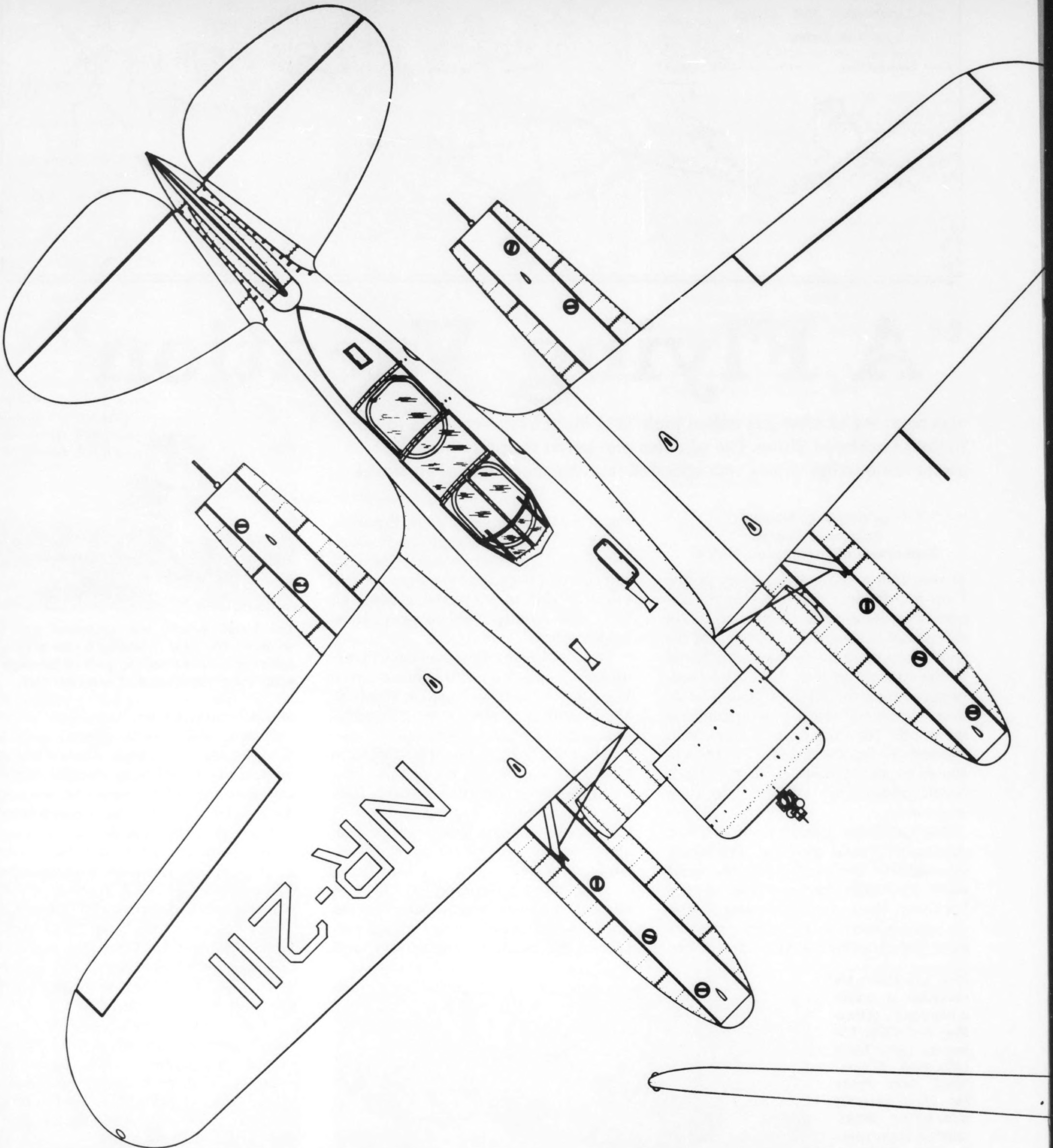
During this mercy operation, the Sirius accidentally capsized while being hoisted overboard from the British aircraft carrier HMS *Hermes*. The severely damaged craft had to be shipped back to the factory for repairs.

This airplane's final contribution to aviation history was a 48,000-kilometer (30,000-mile) survey flight to numerous points across the North and South Atlantic between July and December, 1933. When the Lindberghs stopped in Greenland, an Eskimo boy dubbed the Sirius "Tingmissartoq," meaning "one who flies like a big bird."

Anne Morrow Lindbergh described their extensive Atlantic survey flights in the September, 1934 issue of *National Geographic* and in her book, *Listen! the Wind*. Mrs. Lindbergh's *North to the Orient* recounts the pioneering Great Circle flight.

After the Atlantic survey flights the Sirius was retired and presented to the American Museum of Natural History in New York, and later moved to the Air Force Museum in Dayton, Ohio. It is now owned and exhibited by the National Air and Space Museum.

TURN PAGE for detailed drawings and instructions on building a model of the Sirius. ➡



SPECIFICATIONS

Wingspan	13.05m (42 ft 10 in)
Length, with floats	8.46m (29 ft 9 in)
Height	4.24m (13 ft 11 in)
Weight, gross	3,493 kg (7,699 lb)
Weight, empty	2,082 kg (4,589 lb)
Engine	Wright Cyclone, 710 hp

COLORS

Fuselage and numbers: Black
Wings and tail: Red-orange
Floats, struts, and propeller: Silver
Fuselage stripe: Gold with orange trim

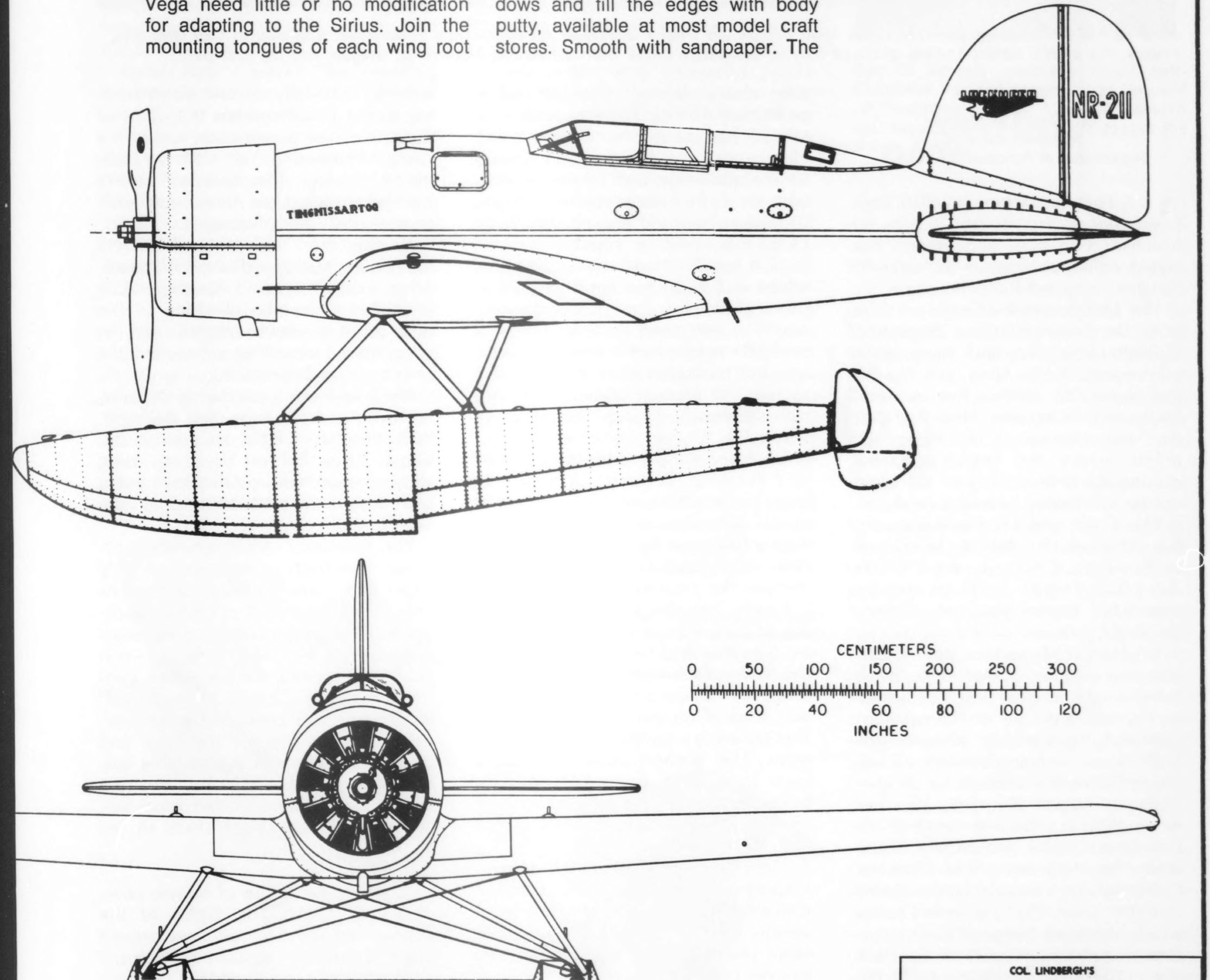
BUILDING THE LOCKHEED SIRIUS

Try your wood-carving skills at modeling this relatively simple airplane design from white pine or other soft woods. Or if you are more comfortable building plastic models, convert a plastic kit. The AMT 1/48 scale Lockheed Vega *Winnie Mae* and (better still) AMT's Lockheed Vega Floatplane both provide the basic components in the correct size for these drawings.

The plastic wings and tail of the Vega need little or no modification for adapting to the Sirius. Join the mounting tongues of each wing root with plastic model cement; set the correct dihedral angle by placing blocks of wood under the wing tips until the cement dries. (See correct angle on front view, below.) The engine and cowl—and the floats from the floatplane model—work well for the Sirius.

Invert the Vega's fuselage and carve away excess plastic so that the wing can be attached and aligned in the correct location. Install the windows and fill the edges with body putty, available at most model craft stores. Smooth with sandpaper. The cockpit is best carved from wood; it also can be formed from thin clear plastic sheet, or a combination of both materials.

Connect and align both floats with spreader bars made from wood or scrap plastic. Attach to the model with struts adapted from the kit. Assemble other components and paint.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TINGMISSARTOQ
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COL. LINDBERGH'S
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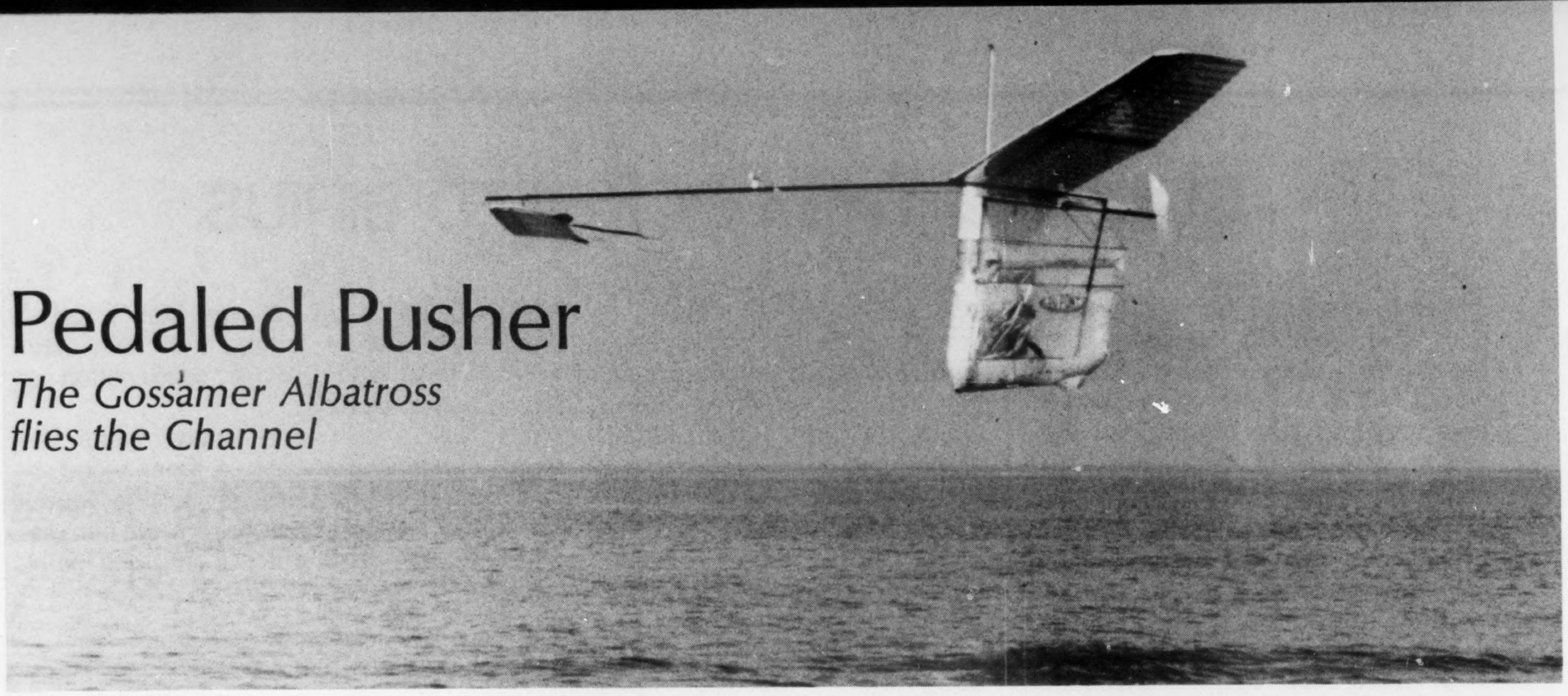
1930
NATIONAL AIR & SPACE MUSEUM
SMITHSONIAN INSTITUTION WASH., D.C.
Drawn By: Edward J. Folz Date: 10-7-68

Pedaled Pusher

The Gossamer Albatross flies the Channel



June 12, 1979: Skimming the sea, Bryan Allen pedals the fragile Gossamer Albatross from Folkestone, England, to Cap Gris Nez, France, the craft's stately 11-mph airspeed belying the pilot's battle with turbulence, headwinds, fatigue, and leg cramps.

by Claudia M. Oakes
Assistant Curator
Department of Aeronautics, NASM

At 8:39 a.m. on June 12, a strange-looking aircraft landed on the beach at Cap Gris Nez, France. The elated crowd cheered as the aircraft's "engine" stepped from the plane.

The aircraft was the *Gossamer Albatross,* the "engine" was a 26-year-old California bicyclist and hang glider pilot named Bryan Allen, and the two had just made aviation history. For 2 hours and 49 minutes Allen had pedaled the *Albatross* 37 kilometers (23 miles) across the English Channel, making the first crossing of the Channel by a human-powered aircraft.

This flight won for the designer of the *Albatross,* Dr. Paul B. MacCready of Pasadena, California, the £100,000 ($215,000) Kremer Prize for the first successful human-powered Channel crossing by air.

Dr. MacCready and his team already had captured an earlier prize established by the wealthy British industrialist Henry Kremer in 1959 for the first sustained, controlled, maneuverable flight by a human-powered aircraft. That prize went unclaimed for 18 years. Then on August 23, 1977, also with Bryan Allen as pilot and "engine," the *Gossamer Condor* successfully negotiated the 1.15-mile (1.84-kilometer) figure-eight course and won the £50,000 ($96,000) prize. The *Gossamer Condor,* which had been designed by Dr. MacCready and Dr. Peter B. S. Lissaman, also of Pasadena, now hangs in the Pioneers of Flight gallery of the Smithsonian's National Air and Space Museum.

As was the first Kremer Prize, the prize for the Channel crossing was administered by the Royal Aeronautical Society of Great Britain, and the rules were clearly defined: The craft had to be heavier-than-air, ruling out balloons; takeoff had to be from the ground, eliminating gliders; the only power source allowable was human muscle, with no assist from propellants, gases, or pushes from the ground. The point of takeoff could be anywhere on the English mainland and the landing anywhere in France, but the flight had to be continuous, and no part of the craft could be jettisoned in flight. The pilot could fly as low to the water as necessary but no higher than 160 feet (48.8 meters), to prevent gliding to France using thermals (rising "bubbles" of warm air).

Dr. MacCready and his crew arrived in Folkestone, England, on May 1 to begin preparations for the flight and to await favorable weather conditions. Even a breeze as light as 10 kilometers/hour (7 miles/hour) could seriously hamper the crossing attempt.

Finally, just after dawn on the morning of June 12, conditions looked better than they had been in weeks: clear sky, calm sea, wind 8 kilometers/hour (about 5 miles/hour). The *Albatross* was readied on the wooden planking that served as a runway atop a concrete quay. The support crew and divers were in position in small boats; the press helicopter was warned to stay well back, lest the rotor wash interfere with the fragile craft's flight.

Allen took his place in the narrow, streamlined fuselage and pedaled down the runway—only to come to an abrupt halt as one of the *Albatross'* small plastic wheels snapped off. The support crew quickly repaired the damage, and soon Allen was really away, generating ½ horsepower at takeoff and traveling at an airspeed of 18-19 kilometers/hour (11-12 miles/hour).

Problems arose halfway across. A headwind developed; the craft lost altitude drastically, at one point coming within 15 centimeters (6 inches) of the water; the temperature inside the cockpit reached 24° C (75° F), causing it to fog; the two-way radio's transmitter failed, so Allen could only receive, not send, messages.

Nearing the 15 kilometers/hour (9.5 miles/hour) stall speed of the *Albatross,* Allen wearily signaled for the rescue boat. But as he was climbing so the boat could maneuver beneath him, he encountered smoother air, waved the boat away, and continued.

His problems were far from over, however, as both legs—first the right, then the left—began to cramp. But Cap Gris Nez lay just ahead, so using all his determination, Allen kept going and eased the *Albatross* onto the beach.

The *Gossamer Albatross* has a 29-meter (96-foot) wingspan, slightly larger than that of a DC-9, but weighs only 25 kilograms (55 pounds). Space-age technology provided the materials from which the craft is made—thin polyester covering for the wings, control surfaces, and pilot's compartment; plastic fibers to connect the controls and brace the interior structure, and 20 plastic pulleys in the steering system. Like the *Condor,* the *Albatross* has a rear-mounted pusher propeller, linked by a lightweight chain to the pedals.

What is the future of human-powered flight? The flights of the *Condor* and the *Albatross* have proved that controlled, sustained, human-powered flight is possible. Designers can now concentrate on applying the technology developed in this field to commercial and sporting possibilities. Bicycling and aviation enthusiasts may soon have a new outlet for their interest and energy!

Will the Space Shuttle become

Everyone's Laboratory in Space?

by Ernest J. Ott
GAS Program Liaison Officer
NASA Goddard Space Flight Center

NASA has made it possible for private citizens to fly experiments on the Space Shuttle Orbiters through a program called the Small Self-Contained Payload (SSCP) Program, popularly known as the Getaway Special (GAS) Program.

Here's how it works: The Sounding Rocket Division of NASA's Goddard Space Flight Center (GSFC) provides a cylindrical pressure container in which the experimenter houses his equipment. That payload is mounted in the Orbiter's cargo bay, placed in Earth orbit, activated by an astronaut if necessary, returned to Earth and, finally, returned to the experimenter.

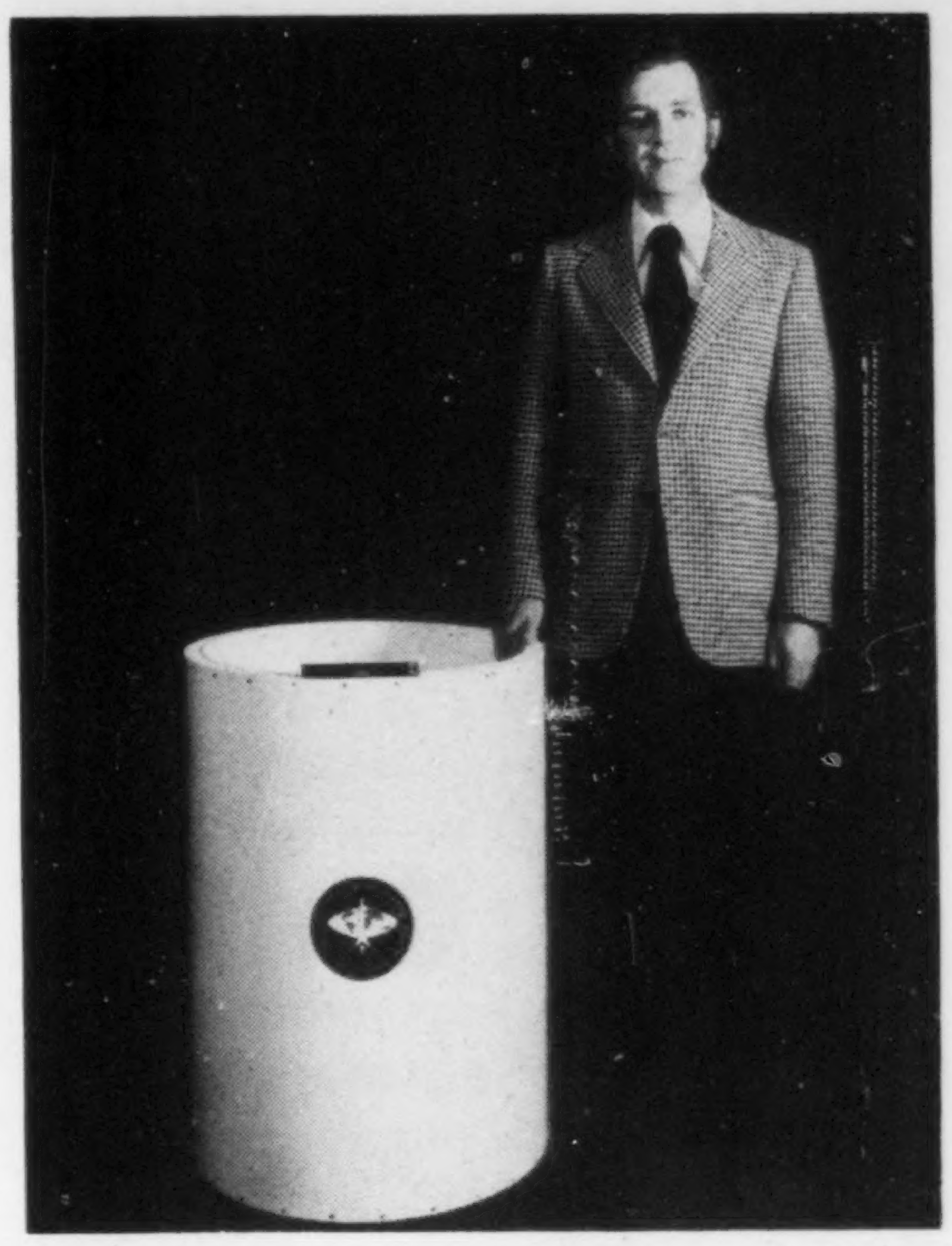
The purposes of the SSCP Program are to encourage the use of space by all researchers—both private individuals and organizations—interested in doing so; foster enthusiasm in the younger generation; and generate new activities unique to space.

The standard SSCP container—which must be used to house all experiments—comes in two sizes: 5 cubic feet (about 142 liters), capable of holding payloads up to 200 pounds; and 2½ cubic feet (about 71 liters), into which payloads of 100 or 60 pounds may be put. The fee for flying these payloads is $10,000, $5,000 and $3,000 (FY 1975 equivalents) respectively.

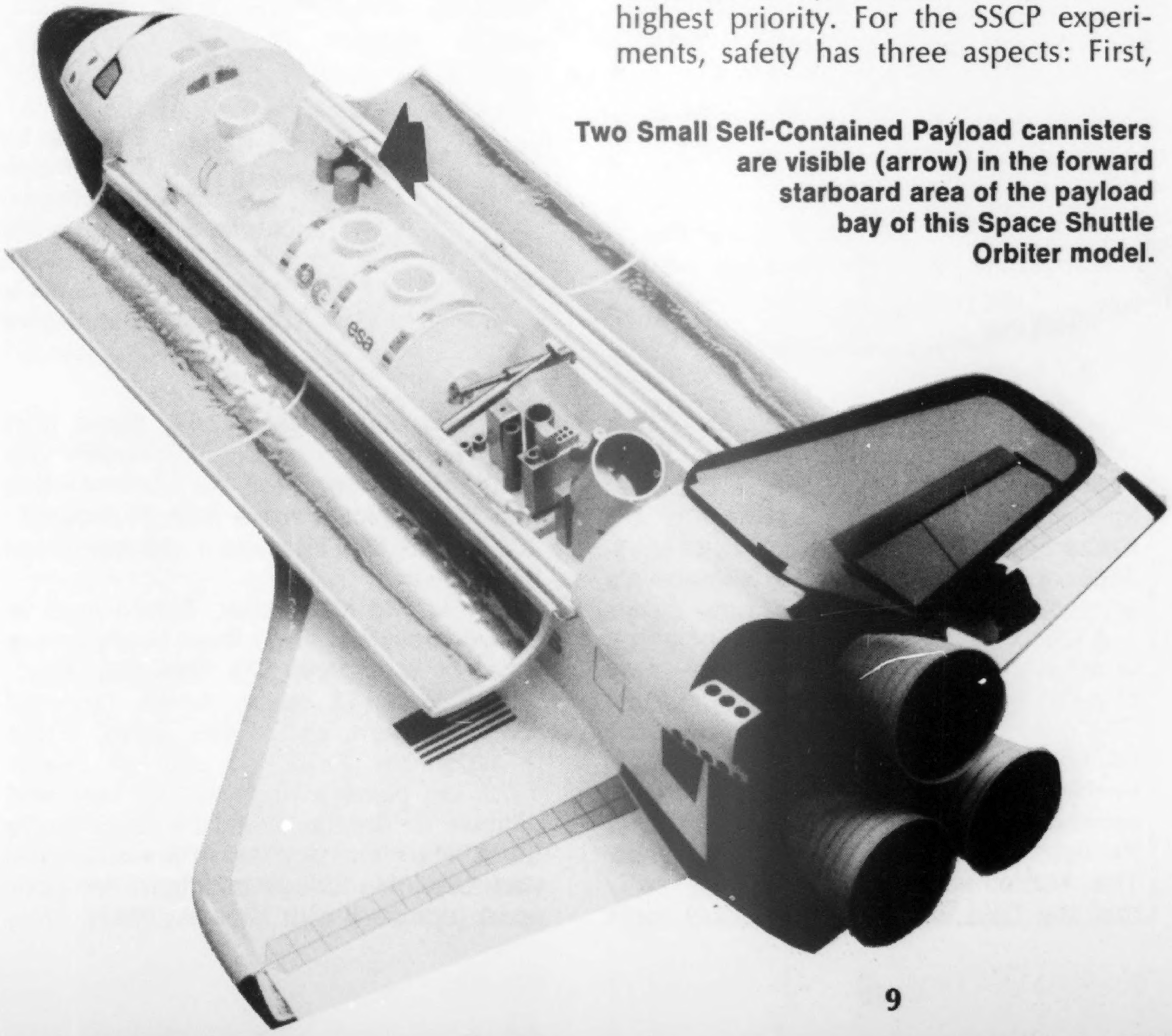
The container usually will have a pressure of one atmosphere, but this can be varied. If the experimenter desires, the container could be placed in orbit with an "Earth-air" environment at one atmosphere, evacuated (while in orbit), and then repressurized with, say, nitrogen at 0.7 atmosphere. Other environments and pressures will be possible.

The crew of the Space Shuttle Orbiter will be available to help operate SSCP experiments. The astronauts will operate as many as three on-off commands for each SSCP payload. For example, an astronaut could turn on the experiment, a tape recorder, and a heater, then turn these units off later. If a particular experiment required more than three commands, the additional commands would have to be provided by means of a suitable timing device, which would be part of the experiment's weight and volume allotment.

Because the Space Shuttle Orbiter is a manned spacecraft, safety has the highest priority. For the SSCP experiments, safety has three aspects: First, the health of the astronauts must not be endangered. Second, the successful operation of the Shuttle Orbiter itself must not be compromised. Third, each experiment must not interfere with the others on board. Each payload will be thoroughly examined—and tested, if necessary—by engineers at GSFC to ensure that it is safe. Engineers and technicians at GSFC will work with SSCP experimenters to help them design and build useful, successful, and safe experiments.



One of several prototype Small Self-Contained Payload cannisters to be used for "Getaway Special" low-cost research and development experiments aboard the Space Shuttle.



Two Small Self-Contained Payload cannisters are visible (arrow) in the forward starboard area of the payload bay of this Space Shuttle Orbiter model.

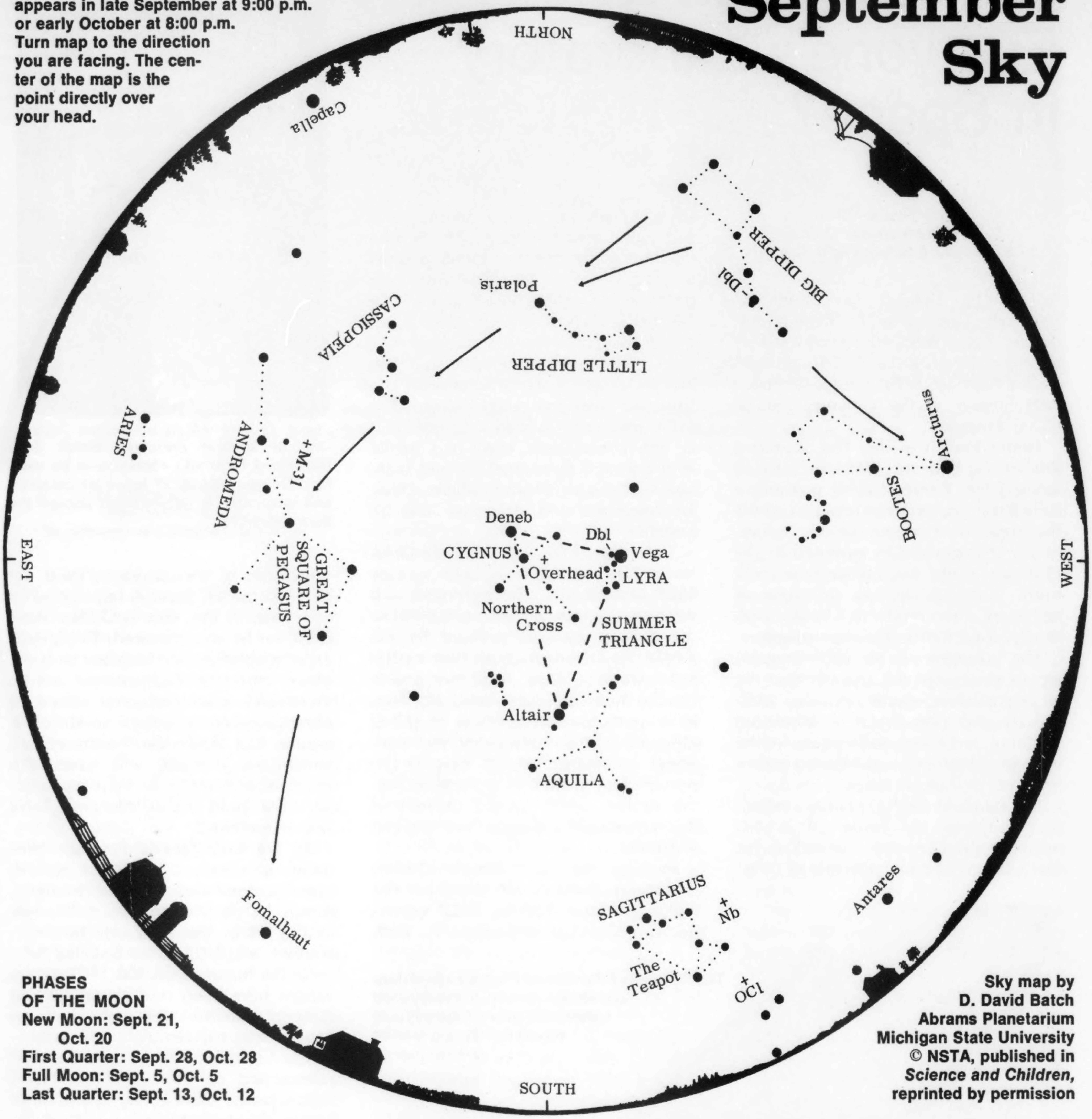
As the SSCP/Shuttle Program continues to develop, extra-cost options may become available. For example, it may be possible to have a window in the lid of the standard container; another possibility is an opening lid.

At this time about 300 SSCP reservations have been made by about 180 different experimenters, ranging from private citizens to foreign governments. Educational institutions are well represented on the list, and include high schools, small colleges, and large universities. Industrial organizations involved in the SSCP/Shuttle Program include companies both large and small, some of which have been engaged in space activities almost as long as NASA, and some that have had no previous connection with NASA or space research.

Persons interested in purchasing an SSCP reservation should contact Donna Skidmore Miller, Code MO-6, NASA Headquarters, Washington, DC 20546. Those wanting more information about the GAS Program should contact the GAS Customer Liaison Officer, Code 740.1, Goddard Space Flight Center, Greenbelt, Maryland 20771.

September Sky

This circle represents the night sky as it appears in late September at 9:00 p.m. or early October at 8:00 p.m. Turn map to the direction you are facing. The center of the map is the point directly over your head.


NORTH
Capella
BIG DIPPER
Dbl
Polaris
LITTLE DIPPER
CASSIOPEIA
ARIES
ANDROMEDA
+M-31
GREAT SQUARE OF PEGASUS
EAST
Arcturus
BOOTES
Deneb
Dbl
CYGNUS
+ Overhead
Vega
LYRA
Northern Cross
SUMMER TRIANGLE
WEST
Altair
AQUILA
Fomalhaut
SAGITTARIUS
+ Nb
The Teapot
+ OCl
Antares
SOUTH

PHASES OF THE MOON
New Moon: Sept. 21, Oct. 20
First Quarter: Sept. 28, Oct. 28
Full Moon: Sept. 5, Oct. 5
Last Quarter: Sept. 13, Oct. 12

Sky map by
D. David Batch
Abrams Planetarium
Michigan State University
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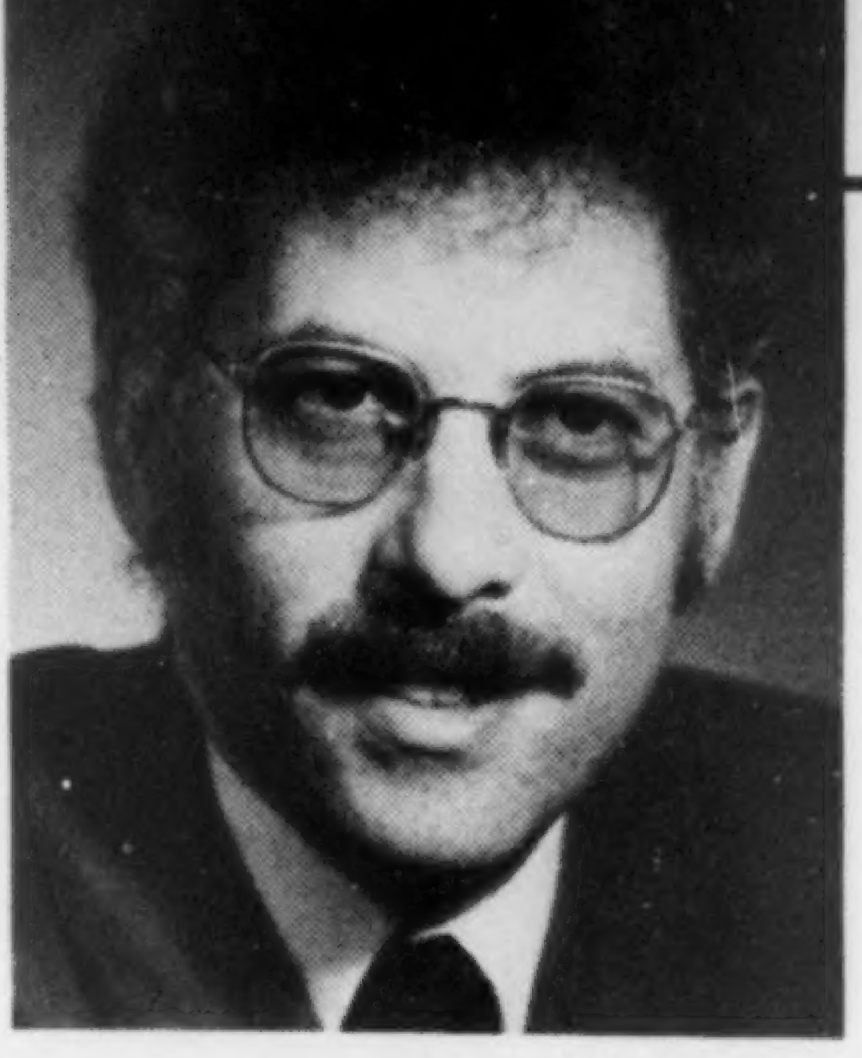
by T. H. Callen II
Production Specialist
Albert Einstein Spacearium, NASM

Although school has started for the year, the Summer Triangle is still visible directly overhead. The Summer Triangle consists of the three brightest stars from three constellations—Lyra (the Harp), Cygnus (the Swan), and Aquila (the Eagle).

If you are far from the atmospheric and light pollution of a city, you can see the diffuse band of light known as the Milky Way crossing the sky overhead. Scanning this band with a pair of binoculars or a small telescope allows one to see what Galileo discovered in 1610: the Milky Way is composed of countless individual stars. These stars are so far from us that their light seems to blend together to the naked eye. The Milky Way, a disk of stars, appears as a band in the sky because we are looking at it edge on from the inside.

Another galaxy (M-31), a near neighbor of our own, appears as a faint, hazy patch of light near the Great Square of Pegasus. This other star city, called the Andromeda Galaxy, is the most distant object visible to the unaided eye. Astronomers refer to an object's distance in terms of how long its light has been traveling toward us. The Andromeda Galaxy is so far away that the light we see today left it more than two million years ago. Since light travels about 9.7 trillion kilometers (six trillion miles) per year, we can calculate that this object is more than 19,000,000,000,000,000,000 kilometers (12 quintillion miles) away.

By the end of October, Saturn rises in the constellation Virgo three hours before the Sun (compare with May Sky Map). The Pioneer 11 space probe, renamed Pioneer Saturn, visited this distant planet in September. From now until the end of 1979, the planet's rings will be faint and difficult to see, as they are edge-on to Earth. Mars and Jupiter, in the constellation Leo, rise about midnight, an hour apart (compare with May Sky Map).



OUTREACH

by Kerry M. Joëls

Chief, Education Division

All forms of life expand their domain by spreading seed, foraging, or competing with other species. But to the best of our knowledge, only man is intellectually inclined to explore beyond his natural habitat into totally hostile environments like deep space or the polar regions.

This issue pays tribute to several of these explorations. Byrd's first flight over the South Pole, the trailblazing of the Lindberghs, and the Pioneer spacecraft's spectacular exploratory visit to Saturn are three outstanding examples of man the explorer.

Some future explorers will be able to purchase space on the Space Shuttle Orbiters for their experiments. This may be the most society-changing exploration of all.

How many thousands of winters did American Indians shiver in their tepees in the midwestern United States? Could those Indians camping over what is now Texas and Oklahoma have realized that a few thousand feet down was what would have been, for them, a limitless supply of energy—to warm them, to power generators for electricity, to drive vehicles to allow faster migration? They did not have the technology to recover or use this resource. It would have drastically altered the Indian way of life, as it did the lives of the people who tapped that resource.

Today we, too, range far from "our campfires," looking for "scraps of wood" to keep for burning, and only by exploring can we open up potentials that we have not yet realized.

Schoolchildren explore continuously. They probe to see how far they can stretch rules; to see how others perceive them; to see where they fit in the social fabric; to find their identity, to learn who they are and what role they play in society.

In a very real sense, the teacher can be the leader of this exploration, and has the option of continuing with available resources or developing supplementary ones. In fact, many of the activities associated with effective learning environments relate directly to the concept of exploring. Open classrooms, inquiry learning, and individually prescribed instruction were predicated on this idea.

Virtually no one has come up with a good scheme for evaluating when effective learning is taking place in a classroom, but somehow good teachers know it when they see it and feel it when it is happening. Isn't this the same intuition and instinct that drove man to find the South Pole, to blaze trails, or to reach out beyond himself to the stars? In a small way we can all do this in our classroom every day.

FORTY YEARS OF JET AVIATION

NASM will sponsor a free public symposium, "Forty Years of Jet Aviation," from 9 a.m. to 4 p.m. on October 26, 1979. Speakers will include some of the foremost pioneers of jet aviation: Air Commodore Sir Frank Whittle; Dr. Hans J. P. von Ohain; Brigadier General Charles E. Yeager; Najeeb Halaby; and John Steiner. All lectures will be held in the Museum's theater. A well-illustrated book, *Forty Years of Jet Aviation,* will be published at the time of the symposium. Edited by Walter J. Boyne and Donald S. Lopez, both of NASM, the book will contain the symposium lectures, plus five additional articles.

MUSEUM HOURS

Museum hours after Labor Day (September 4) are 10 a.m. to 5:30 p.m., seven days a week. The Museum is closed Christmas Day.

SPACEARIUM SHOP

A price list of all aerospace items available by mail through NASM's Spacearium Shop may be obtained on request by writing to Room P701, National Air & Space Museum, The Smithsonian Institution, Washington, DC 20560.

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In view of financial limitations, *Air & Space* is not accepting any new registrations at this time.

Back issues of *Air & Space* are available through University Microfilms International, Inc., 300 N. Zeeb Road, Ann Arbor, Michigan 48106.

LUNAR LANDING BOOK

To commemorate the tenth anniversary of the first manned landing on the Moon, NASM has published a new book, *Apollo: Ten Years Since Tranquillity Base.*

Issued by the Smithsonian Institution Press, this book contains a series of essays that examine the political and social climate that led to the lunar landing, as well as the technological and scientific implications of the event. The commemorative volume was edited by Richard P. Hallion and Tom D. Crouch, both of NASM. The book sells for $6.95 paperback, $17.50 hardcover, and is available at NASM and local bookstores. It also can be ordered through the Smithsonian Press, Box 1576, Washington, DC 20013. Postage and handling charge is $1.25 for the first book, $0.50 for each additional copy.

ILLUSTRATION CREDITS
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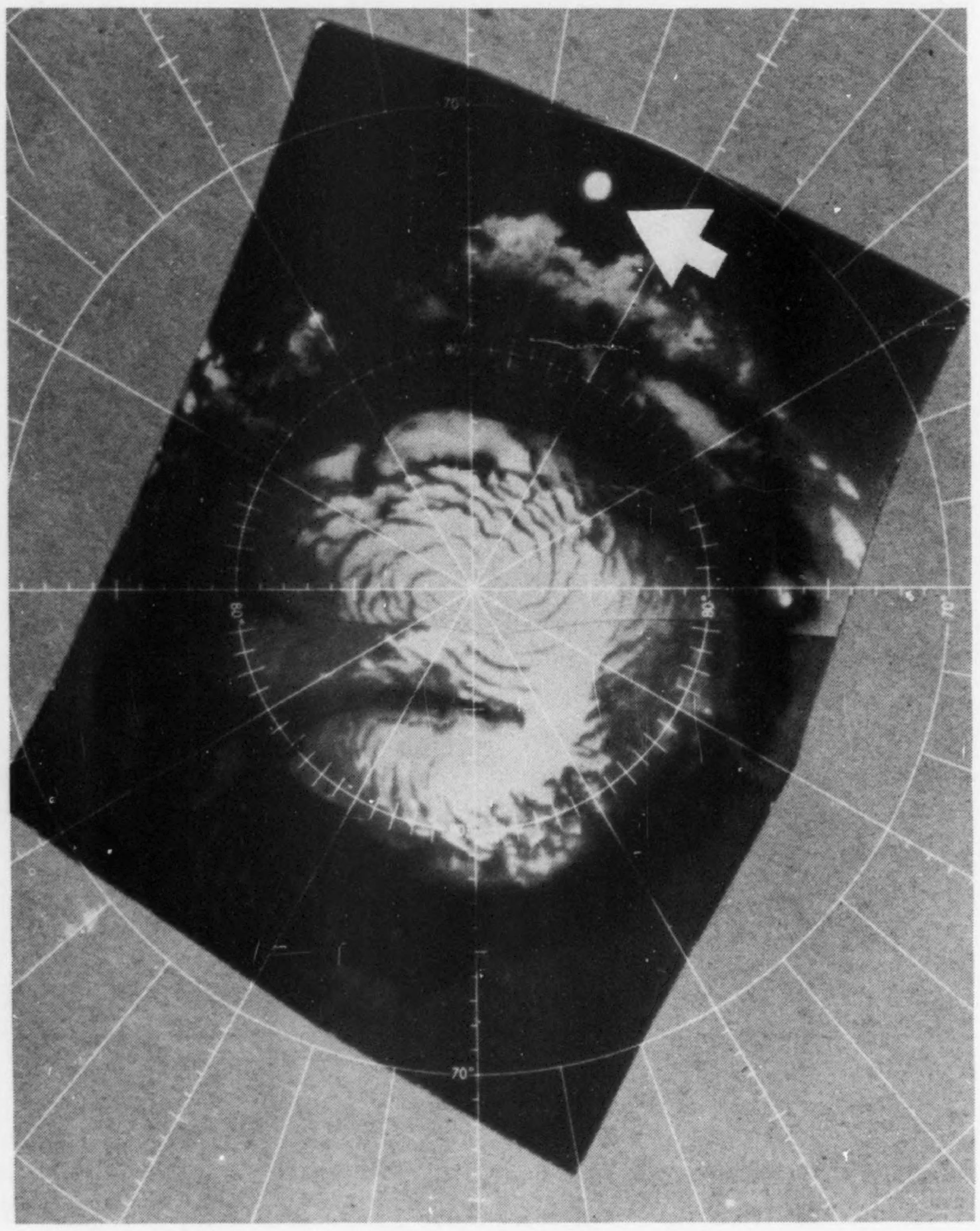
THINK ALONG WITH PLANETARY SCIENTISTS

about Mars' mysterious polar icecaps

Air & Space, Sept.-Oct. 1979



Mars' irregularly shaped north polar ice cap appears as the light-colored area in the center of this Mariner 9 mosaic photo, overlaid with a grid of Mars' polar coordinates. The frost in the north polar region was nearing its minimum size approximately two weeks after the martian summer solstice (October, 1972). Note the crater (indicated by the arrow); it trapped and shielded frost from the Sun, leaving a large patch on its floor.

For more on mankind's exploration of Earth's South Pole from the air and space, see pages 1-4, "Surveying Antarctica: From Dogsled to Satellite."

by Robert W. Wolfe
Geologist
Center for Earth and Planetary Studies, NASM

Most of the Earth's water—more than 97%—is in the oceans; most of the remainder exists as ice in the polar regions, and not as liquid water in lakes or streams or in rocks and soil.

If we ignore the absence of our huge oceans, Mars does not seem very different from Earth with respect to the distribution of water. Pictured here is Mars' permanent north polar ice cap as seen by Mariner about a decade ago. Most (but probably not all) of Mars' water is found in this great icecap and the somewhat smaller southern polar cap.

One of the first discoveries of the Viking orbiter spacecraft in 1976 was that Mars' permanent icecaps are, indeed, composed of water ice. In addition to the permanent caps, each polar region is blanketed with carbon dioxide frost (dry ice) during winter in its hemisphere. These seasonal changes have been observed and studied by Earth-based astronomers for centuries.

With instruments aboard the Viking orbiters and landers, it was possible to study the movement of *volatiles* (i.e., substances readily vaporized at a relatively low temperature), such as water and carbon dioxide, in the martian atmosphere. For example, as spring arrives in the northern hemisphere, water begins to evaporate from the north polar cap. Later, during the martian summer, this evaporated water migrates toward the colder south polar region, where it condenses as ice on the polar cap. As spring comes in the south, the process is reversed, and water moves northward. Scientists believe that the situation is similar for carbon dioxide.

Recent observations suggest that abundant water may be trapped in the soil in Mars' equatorial region. Certainly, it appears that Mars once was blessed with more water than we have found there today. Photographs of the red planet reveal landforms that are strikingly similar to permafrost (soil laden with ice) terrains of Earth. Others show evidence of erosion by rivers and great floods.

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